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Dual-polarisation Raman microscopy for live cell imaging

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Raman spectroscopy has been established as a useful technique to study biological samples because of its label-free nature. By measuring the spatially and temporally resolved Raman spectra of a sample, it is possible to construct a series of hyperspectral Raman images of the observed area for the study of chemical distributions and dynamics *in situ* or *in vivo*[1]. One of the major challenges in the Raman spectroscopic study of live cells is to extract as much chemical information from the complicated spectra as possible. In this study, we exploited the polarisation property of Raman scattering to increase the selectivity of the spectrum[2] and developed a new Raman micro-spectroscopic system that is able to obtain the two orthogonally polarised Raman images with different chemical contrasts simultaneously. Fig. 1 shows the dual-polarisation Raman images and two polarised Raman spectra from mitochondria of a living cell. It is clear that different spectra and chemical contrasts are shown in the two different polarisations. This is the first demonstration of the dual-polarisation Raman imaging of cells.

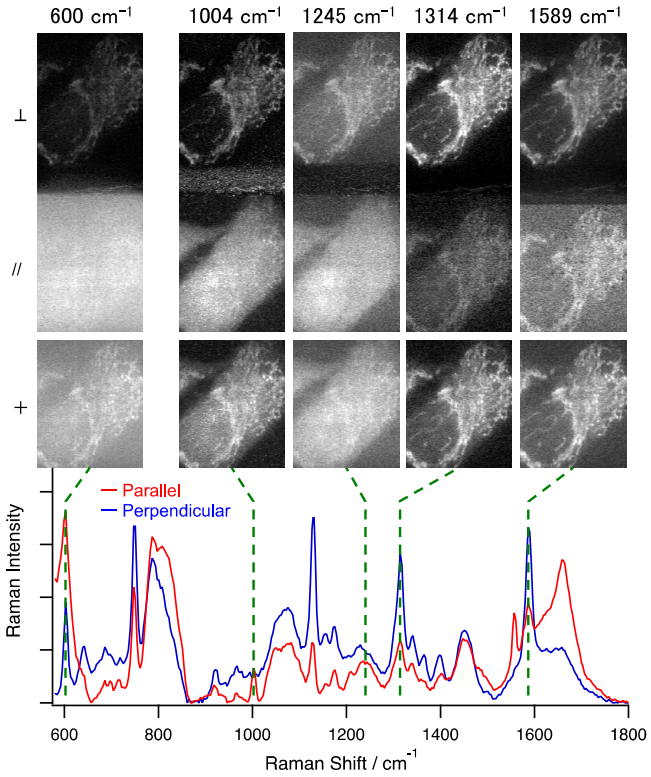

Fig. 1 Dual-polarisation Raman spectral imaging of a living cell

Our dual-polarisation Raman imaging technique is especially useful in the resonance enhanced Raman spectroscopic study of cellular cytochrome c content because it not only enhances the contrast of the cytochrome c images but also removes most side effects caused by using short wave length lasers. The results demonstrate that dual-polarisation Raman imaging actually improves the performance of Raman micro-spectroscopes and enabled us to extract more detailed chemical information from living cells than we could before.

1. Okada, M. *et al. Proc. Natl. Acad. Sci.* **109,** 28–32 (2012).

2. Chiu, L. *et al. Proc. SPIE* **8587,** 858720–858720–6 (2013).